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Kansainvälinen patentihakemus nro  
International patent application no PCT/FI98/00476

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Keksinnön nimitys  
Title of invention

"Procedure for the control of a subscriber identity  
module in a data communication system, and a data  
communication system"

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## REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

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International Filing Date  
02 JUN 1998 (02.06.98)

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Applicant's or agent's file reference  
(if desired) (12 characters maximum) 10362S

**Box No. I TITLE OF INVENTION** PROCEDURE FOR THE CONTROL OF A SUBSCRIBER IDENTITY MODULE IN A DATA COMMUNICATION SYSTEM, AND A DATA COMMUNICATION SYSTEM

**Box No. II APPLICANT**

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)

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## Box No. VI PRIORITY CLAIM

Further priority claims are indicated in the Supplemental Box 

The priority of the following earlier application(s) is hereby claimed:

Country (in which, or for which, the application was filed)	Filing Date (day/month/year)	Application No.	Office of filing (only for regional or international application)
item (1) FI	4 June 1997 (04.06.1997)	972369	
item (2)			
item (3)			

*Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required):* The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s): \_\_\_\_\_

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Earlier search Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request:

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## Box No. VIII CHECK LIST

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4. abstract : 1 sheets	4. <input checked="" type="checkbox"/> priority document(s) identified in Box No. VI as item(s):
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Total : 18 sheets	5. <input checked="" type="checkbox"/> fee calculation sheet
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Figure No. \_\_\_\_\_ of the drawings (if any) should accompany the abstract when it is published.

## Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

PAPULA REIN LAHTELA OY

Markku Simmelvuo

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1. Date of actual receipt of the purported international application:	02 JUN 1998 (02-06-1998)
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PROCEDURE FOR THE CONTROL OF A SUBSCRIBER IDENTITY  
MODULE IN A DATA COMMUNICATION SYSTEM, AND A DATA  
COMMUNICATION SYSTEM

The present invention relates to a procedure  
5 as defined in the preamble of claim 1 for the control  
of a subscriber identity module in a data communicati-  
on system, preferably a mobile telephone network. Mo-  
reover, the invention relates to a data communication  
system as defined in the preamble of claim 8.

10 In a mobile communication system, subscriber  
data are stored in a unit or device specially designed  
for data management. For instance, in the GSM system  
such a device is the home location register (HLR).  
Stored in this register are certain parameters related  
15 to the subscriber or subscription, such as the mobile  
subscriber international ISDN number (MSISDN) and in-  
ternational mobile subscriber identification (IMSI)  
code.

20 In practice, the capacity of a single physi-  
cal home location register is limited. The home loca-  
tion register devices used in the GSM system can typi-  
cally handle about 200000 - 300000 customers. Therefo-  
re, big operators need several home location register  
devices.

25 The data contained in the subscriber identity  
module used in a mobile communication system includes  
the same data that are stored in the home location re-  
gister. In addition to these data, the subscriber  
identity module contains a secret key  $K_i$  used for en-  
30 cryption of radio communication and authentication of  
the mobile station. The data are generally added at  
the last stage of production of the subscriber identifi-  
ty module in conjunction with its personalisation. Af-  
ter this, changing the data is either very difficult  
35 or impossible.

The customer may lose his/her subscriber identity module or the module may be damaged. Therefore, the operator must store subscriber identity modules suited for all home location registers at each 5 customer service point if the operator wants to provide a flexible and full service regarding the renewal and control of subscriber identity modules. If the operator has e.g. 20 home location registers in its mobile communication system, then the customer service 10 points must have an assortment of 20 subscriber identity modules containing different data. This gives rise to a distinct logistic problem as well as a problem of efficiency regarding the capital invested in subscriber identity modules.

15 The object of the present invention is to eliminate the drawbacks described above. A specific object of the present invention is to present a new type of procedure for the control of subscriber identity modules in a data communication system.

20 A further object of the invention is to present a device that can be used to change the data in a subscriber identity module to implement a flexible control of the module.

A further object of the invention is to give 25 the operator a chance to improve customer service. A specific object is to improve the service relating to the change of subscriber identity modules and replacement of damaged modules.

As for the features characteristic of the invention, reference is made to the claims. 30

In the procedure of the invention for the control of a subscriber identity module, which contains a subscriber identity code and a secret key, in a data communication system, such as a mobile communication network, comprising a subscriber register for 35 the maintenance of a subscriber identity module register, a message transmission system for the transmissi-

on of a message in the mobile communication network, and a mobile station to which the subscriber identity module is connected, a record is created in the subscriber register when the first subscription for a 5 subscriber is opened, said record comprising a call number specific to the subscription, an encryption code and a subscriber identity code associated with the subscription. In addition, services specified for the subscriber in the mobile communication network can be 10 stored in a home location register. The home location register is preferably a register in a GSM mobile communication network and contains subscriber specific information relating to right of use and functions. When the subscriber enters the area of a mobile communication switching centre, the mobile station reports 15 to its visitor location register (VLR). The mobile communication switching centre then fetches the subscriber data from the subscriber's home location register and sends them to the visitor location register of its own area and simultaneously updates the location data for the subscriber.

As stated above, large mobile communication networks comprise several home location registers. Furthermore, the range of subscriber identity codes 25 (IMSI) of a single home location register can be divided into several sections, which means that, in respect of control of subscriber identity modules, a single physical subscriber register device may comprise several subscriber registers (different IMSI ranges).

According to the invention, a second subscription associated with the subscriber identity module is opened. At the same time, a record comprising the call number, subscriber identity code and key 35 corresponding to the second subscription is created in a subscriber register, which generally is different from the home location register containing the record

for the first subscription. A message comprising an instruction for changing the data corresponding to the first subscription in the subscriber identity module is sent to the first subscription and further to the 5 subscriber identity module, and, based on the message, the data corresponding to the first subscription stored in the subscriber identity module are changed into data corresponding to the second subscription. Thus, the subscriber identity module and the mobile station 10 to which the subscriber identity module is connected will function in accordance with the services and functions defined for the second subscription.

As compared with prior art, the invention has the advantage that it makes it possible to significantly simplify the control of subscriber identity 15 modules even in large mobile communication systems.

A further advantage of the invention is that the operator of the mobile communication network can avoid the logistic problem caused by the use of multiple different subscriber identity modules. Moreover, the procedure of the invention allows better and faster customer service in respect of subscriber identity 20 modules.

In an embodiment of the invention, a message 25 is received and the data are changed when the mobile station is switched on for the first time with the subscriber identity module connected to it. Upon receipt of the message, an acknowledgement of receipt of the message is sent. Based on the acknowledgement, 30 the mobile communication system removes the first subscription from the data communication system and from the home location register. It is also possible to send the acknowledgement only after the subscriber identity module has processed the message, thus making 35 sure that the data in the subscriber identity module have been changed.

In an embodiment of the present invention, the system waits for an acknowledgement of receipt of the message for a predetermined period of time, e.g. 24 h, and if no acknowledgement is received within 5 this period, the message is sent again. The new message can also be sent to both subscriptions, because it is possible in certain conditions that the data in the subscriber identity module have already been changed but no acknowledgement has been sent before 10 the mobile station loses connection with the network. This guarantees that the mobile station and the subscriber identity module will receive the message sent and, based on the message, carry out the changes in the subscriber identity module and that the 15 subscriber data in the mobile communication system remain up to date.

In an embodiment, acknowledgement of receipt of the message can be regarded as consisting of the occurrence of a mobile station corresponding to the 20 second subscription being attached to the system (IMSI attach). In conjunction with the changing of the data in the subscriber identity module, the subscriber identity code corresponding to the first subscription is deleted from the subscriber identity module. In addition, the temporary mobile subscriber identity 25 (TMSI) code can be deleted.

According to the invention, the data communication system of the invention, such as a mobile communication network, comprises a control device, which 30 comprises means for opening a second subscription associated with the subscriber identity module; means for creating a record in the subscriber register, said record comprising the call number, subscriber identity code and key corresponding to the second subscription. 35 Further, according to the invention, the data communication system comprises means for generating a message to be sent to the first subscription, said message

containing an instruction for changing the data corresponding to the first subscription in the subscriber identity module, and means for changing the data corresponding to the first subscription stored in the 5 subscriber identity module into data corresponding to the second subscription.

The control device is preferably disposed in conjunction with a billing and customer control system in the data communication system or mobile communication network. Further, the message transmission system used in the system of the invention may be a short- 10 message system as known in the GSM system.

In the following, the invention will be described by the aid of examples of preferred embodiments by referring to the attached drawing, which is a 15 diagram representing a data communication system according to the invention.

The data communication system shown in the drawing, preferably a GSM system, comprises a mobile 20 station MS, a subscriber identity module SIM connected to the mobile station, and, in the mobile station, means 5 for changing the data corresponding to the first subscription and stored in the subscriber identity module into data corresponding to the second subscription. In the mobile station, said means 5 are preferably 25 implemented as part of a device controlling the subscriber identity module or as part of the subscriber identity module SIM itself.

In addition, the data communication system 30 presented in the drawing comprises a short-message switching centre SMSC and a base station controller BSC. The base station controller further comprises a home location register HLR1, HLR2.

The system presented in the drawing further 35 comprises a control device 1 disposed in conjunction with the billing and customer control system (not shown). In addition, the drawing shows an agency appa-

ratus 6 provided at an agency that sells subscriptions and used to transmit the service and function data relating to a new subscription to the data communication system. In the drawing, the signalling occurring between the various devices is represented by arrows. The direction of the arrow indicates the signalling direction.

The control device further comprises means 2 for opening a second subscription, means 3 for creating a record in the subscriber register and means 4 for generating a message to be sent to the first and/or second subscription. These means 2, 3, 4 can preferably be implemented in one and the same computer, which is provided with suitable software for carrying out the aforementioned functions and with a suitable interface for connecting the computer to the mobile communication network 7. With this arrangement, the properties and functions of the means can be flexibly changed by changing the software used in the computer.

Further, referring to the drawing, in a preferred example embodiment of the invention, the seller of the subscription provides the international mobile station identity IMSI code of the subscriber identity module and the international telephone number of the subscription. This number pair is transmitted via the agency apparatus 6 to the control device 1. The control device 1 then opens in the billing and customer control system two subscriptions, whose parameters are: (IMSI<sub>1</sub>, MSISDN<sub>x</sub>, K<sub>i</sub>) and (IMSI<sub>2</sub>, MSISDN, K<sub>i</sub>), where IMSI corresponds to the subscriber identity code, MSISDN corresponds to the international telephone number and K<sub>i</sub> corresponds to the secret key used for encryption of radio communication and for authentication of the mobile station. Based on the function, records are also created in the first subscriber register HLR1 and in the second subscriber register HLR2, respecti-

vely. In this example, the subscription corresponding to the first subscriber identity code IMSI1 contains only one service, the short-message service. For the subscription corresponding to the second subscriber 5 identity code IMSI2, the services chosen by the subscriber are activated and corresponding information is sent to the control device 1 via the agency device 6.

After the two subscriptions have been opened, 10 the control device of the invention sends a short message SMS corresponding to the MSISDNx telephone number to the first subscription via the short-message switching centre SMSC. After the short message has been sent by the short-message switching centre and 15 received by the mobile station to which the subscriber identity module is connected, then the IMSI1 code in the subscriber identity module SIM of the mobile station is changed to the value IMSI2, and the ISMS1 and TIMSI codes in the subscriber identity module are deleted. 20 After this, when the mobile station is switched off and switched on again, the data in the subscriber identity module will be those corresponding to the second subscription, i.e. the subscription for which the subscriber identity code is IMSI2 and for which the 25 international telephone number is MSISDN.

Moreover, the mobile station sends an acknowledgement of receipt of the short message and when the acknowledgement is received by the control device 1 of the invention, the control device will delete the data 30 corresponding to the first subscription from the billing and customer control system. However, it is possible that the mobile station is switched off before the acknowledgement is sent and the data changed, in which case the rest of the system will not know that 35 the subscription has been changed. For this reason, in an embodiment of the invention, the control device is provided with a timeout for monitoring the receipt of

the acknowledgement. If no acknowledgement is received within a given period of time, e.g. 24 h, then the short message is sent to the mobile station number MSISDN corresponding to the second subscription. When 5 an acknowledgement is received for either one of the messages, then, based on the acknowledgement, the data corresponding to the first subscription are deleted from the billing and control system.

In addition, it is possible that the deletion 10 of the data occurs as a consequence of an action carried out by another customer or by a terminal device held by another customer. A possible action of this nature might be e.g. the first attachment (IMSI attach) of another subscription received in a mobile 15 communication network, of which a notice is transmitted to the service control device.

In summary, let it be further stated that the solution of the invention combines the use of prior-art short messages and the use of a subscriber register and a billing and customer control system. Via 20 this solution, an operations model is created according to which the operator only needs to order a single type of subscriber identity modules but is still able to offer flexible card change services at all 25 customer service points. It is further to be noted that the mobile communication network also provides other possibilities that can be utilised for the transmission of the message to the subscriber identity module.

30 The invention is not restricted to the examples of its embodiments described above, but many variations are possible within the scope of the inventive idea defined by the claims.

## CLAIMS

1. Procedure for the control of a subscriber identity module (SIM), which contains a subscriber identity code (IMSI<sub>1</sub>) and a key (K<sub>i</sub>), in a data communication system, such as a mobile communication network, comprising a subscriber register (HLR1, HLR2) for the maintenance of a subscriber identity module register, a message transmission system (SMSC) for the transmission of a message in the mobile communication network, and a mobile station (MS) to which the subscriber identity module is connected, in which procedure a record is created in the subscriber register (HLR1) when a first subscription is opened, said record comprising a subscription specific call number (MSISDN<sub>x</sub>), an encryption code (K<sub>i</sub>) and a subscriber identity code (IMSI<sub>1</sub>) associated with the subscription, characterised in that  
a second subscription associated with the subscriber identity module (SIM) is opened;  
a record comprising the call number (MSISDN), subscriber identity code (IMSI<sub>2</sub>) and encryption key (K<sub>i</sub>) corresponding to the second subscription is created in the subscriber register (HLR2);  
a message (SMS) containing an instruction for changing the data corresponding to the first subscription in the subscriber identity module (SIM) is sent to the first subscription; and  
based on the instruction, the data corresponding to the first subscription stored in the subscriber identity module are changed into data corresponding to the second subscription.
2. Procedure as defined in claim 1, characterised in that an acknowledgement of receipt of the message (SMS) and successful change is sent from the subscriber identity module (SIM) and,

based on the acknowledgement, the first subscription is removed from the data communication system.

3. Procedure as defined in claim 1 or 2, characterised in that the message (SMS) is sent to the second subscription, an acknowledgement of receipt of the message is sent from the second subscription and, based on the acknowledgement, the first subscription is removed from the data communication system.

10 4. Procedure as defined in any one of the preceding claims 1 - 3, characterised in that the system waits for an acknowledgement of receipt of the message for a predetermined period of time and, if no acknowledgement is received within 15 this period, the message is sent again to the second subscription.

20 5. Procedure as defined in any one of the preceding claims 1 - 4, characterised in that the first subscription is removed when attachment of the second subscription to the data communication system is detected in the system.

25 6. Procedure as defined in any one of the preceding claims 1 - 5, characterised in that a corresponding temporary subscriber identity code (TMSI) stored in the subscriber identity module is removed.

30 7. Procedure as defined in any one of the preceding claims 1 - 6, characterised in that the data communication system is a GSM mobile communication system.

35 8. Data communication system, such as a mobile communication network, for controlling a subscriber identity module (SIM) containing a subscriber identity code (IMSI<sub>1</sub>) and a key (K<sub>i</sub>), said data communication system comprising a subscriber register (HLR<sub>1</sub>, HLR<sub>2</sub>) for the maintenance of a subscriber identity module register, a message transmission system (SMSC) for the

transmission of a message in the mobile communication network, and a mobile station (MS) to which the subscriber identity module is connected, in which data communication system a record is created in the 5 subscriber register (HLR1) when a first subscription is opened, said record comprising a subscription specific call number (MSISDN<sub>x</sub>), an encryption code (K<sub>i</sub>) and a subscriber identity code (IMSI1) associated with the subscription, characterised in that the 10 data communication system comprises a control device (1), which comprises

means (2) for opening a second subscription associated with the subscriber identity module (SIM);

15 means (3) for creating a record in the subscriber register (HLR2), said record comprising the call number (MSISDN), subscriber identity code (IMSI2) and key (K<sub>i</sub>) corresponding to the second subscription;

20 means (4) for generating a message (SMS) to be sent to the first subscription, said message containing an instruction for changing the data corresponding to the first subscription in the subscriber identity module; and

25 means (5) for changing the data corresponding to the first subscription stored in the subscriber identity module into data corresponding to the second subscription.

30 9. Data communication system as defined in claim 8, characterised in that the control device (1) is disposed in conjunction with a billing and customer control system in the data communication system.

35 10. Data communication system as defined in claim 8 or 9, characterised in that the message transmission system (SMSC) is a short-message system.

## (57) ABSTRACT

Procedure and system for the control of a subscriber identity module (SIM) containing a subscriber identity code (IMSI1) and a key ( $K_1$ ) in a data communication system, such as a mobile communication network, comprising a subscriber register (HLR1, HLR2) for the maintenance of a subscriber identity module register, a message transmission system (SMSC) for the transmission of a message in the mobile communication network, and a mobile station (MS) to which the subscriber identity module is connected, in which procedure a record is created in the subscriber register when a first subscription for the subscriber is opened, said record comprising a subscription specific call number (MSISDN<sub>x</sub>), an encryption code ( $K_i$ ) and a subscriber identity code (IMSI1) associated with the subscription. According to the invention, a second subscription associated with the subscriber identity module (SIM) is opened; a record comprising the call number (MSISDN), subscriber identity code (IMSI2) and encryption key ( $K_i$ ) corresponding to the second subscription is created in the subscriber register (HLR2); a message (SMS) containing an instruction for changing the data corresponding to the first subscription in the subscriber identity module (SIM) is sent to the first subscription; and, based on the message, the data corresponding to the first subscription stored in the subscriber identity module are changed into data corresponding to the second subscription. After making sure that the operation has been successfully carried out in the subscriber identity module (SIM), the first subscription is removed from the data communication system.

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